# THE WEATHER AND CIRCULATION OF NOVEMBER 1952

## A Pronounced Reversal From October [1]

HARRY F. HAWKINS, JR.

Extended Forecast Section, U. S. Weather Bureau, Washington, D. C.

### CONDITIONS AT BEGINNING OF NOVEMBER

November 1952 was preceded by the driest October on record in the United States. Figure 1, reproduced from the October article [1], shows again the circulation pattern associated with the Nation-wide drought which prevailed everywhere but the Florida peninsula. The circulation around a massive ridge over western North America effectively shut off almost all of the moisture normally supplied by the Pacific and the Gulf of Mexico. Contributions of Atlantic moisture were also minimized because dry west-northwesterly flow reached almost to the Atlantic Coast. As November began, the effects of wide-spread and persistent drought were everywhere evident. In the Far Northwest, plans for hydroelectric power rationing were discussed; over the western grazing lands, drying and burning pastures led to heavy cattle marketing; on the Plains, winter wheat which had been drilled in the dust lay ungerminated; in the South and East, countless grass and forest fires, many uncontrolled, created a smoke pall which noticeably affected visibilities

[1] See Charts I–XV following page 231 for analyzed climatological data for the month.

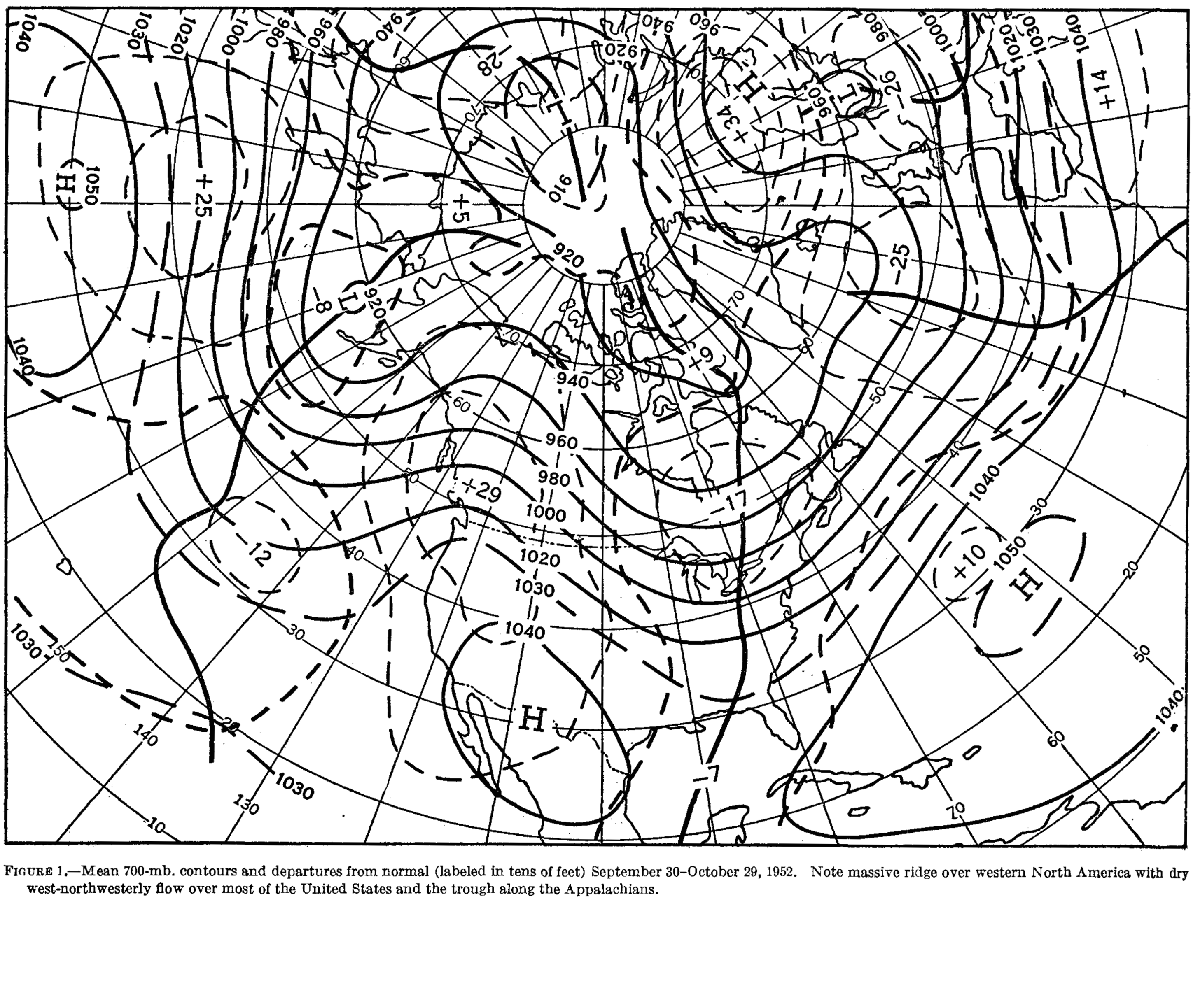



FIGURE 1.—Mean 700-mb. contours and departures from normal (labeled in tens of feet) September 30–October 29, 1952. Note massive ridge over western North America with dry west-northwesterly flow over most of the United States and the trough along the Appalachians.

and temperatures and finally resulted in the closing of many outdoor recreation areas.

## A SLOW TRANSITION

During the first week of November little occurred to alleviate these conditions; indeed, over most areas the drought intensified. However, on the 6th a 45-day rainless period in Louisiana and southern Mississippi was ended but by only light precipitation. On the 9th and 10th heavy rains in Louisiana, Mississippi, Arkansas, and Tennessee greatly relieved the autumn drought, and the East received enough precipitation to ease the dangerous fire hazard. In the Far West, precipitation began to spread about the 10th. On the 13th Salt Lake City had its first precipitation after 62 rainless days. Rain or snow over the West continued for about a week and greatly alleviated the extreme conditions, although the hydroelectric facilities in the Northwest still faced a serious water shortage at the month's end. During the latter half of the month heavy rains began again in the western Mississippi Valley and spread gradually eastward and northeastward, followed by recurrent precipitation in the Mississippi Valley for the remainder of the month. It was during this period that a last area, the North Central portion, obtained its first sensible precipitation.

The net effect of these developments was that almost the entire Nation received substantial relief from a singularly widespread and critical drought. In this report the scope and nature of the circulation changes which resulted in the breaking of the drought will be examined, especially as they relate to a recent study by Namias [2] concerning the annual cycle in persistence of monthly anomalies.

## THE FIRST HALF OF NOVEMBER

Figure 2 shows the mean 700-mb. heights for the first 15 days of November. When compared to figure 1, these major changes in the circulation pattern are immediately evident:

1. The Pacific was dominated by a single broad cyclonic flow—a marked reversal from the well-defined wave pattern of October.
2. The eastern Atlantic trough of October was replaced by a strong anti-cyclonic circulation which became established as a mid-latitude block.
3. Trough conditions intensified markedly over Europe.
4. The cyclonic cell near Novaya Zemlya during October was replaced by a strong ridge.

Contrasted to these phase changes of almost 180 degrees over much of the hemisphere, the pattern in northern North America showed no comparable shift. The ridge in western Canada weakened greatly and the eastern continental trough moved eastward, but phase relations were basically the same. A more important change, however, occurred at lower latitudes where the California coastal trough almost eliminated the intense ridge of October. This development may be regarded as the relaxation of what would otherwise have been an excessively long wave length at low latitudes.

The weather anomalies in the United States accompanying the circulation pattern for the first half of November are shown in figure 3 and may be compared with those of figure 4 for October.[2] These figures show that during the first half of November rather cool Pacific air began to affect the western United States. As the western ridge weakened, perturbations from the developing California trough released substantial precipitation amounts as they traversed the southern United States. This latter activity was generally more evident at upper levels than at sea level, and its area of influence is indicated by the extreme separation of the 10,000- and 10,200-ft. contours over western United States. The precipitation in the southern Mississippi Valley was a result of the first of these disturbances which, after traversing the West, received a strong injection of Gulf moisture. Warming over the central United States was directly attributable to the weakened ridge over western Canada and the consequent diminution of the cold, dry, northwesterly flow which had prevailed in October.

Inspection of Chart X reveals that the Gulf of Alaska and Davis Strait were favored sites for cyclonic activity, as would be expected from the location of the centers of action at 700 mb. (fig. 2). The storms which affected the United States were generally related to upper level per-

[2] Class intervals are determined for the various locations and seasons by statistical analysis of past records. Temperature classes above, near, and below normal are so defined that each normally occurs one-fourth of the time; much above and much below, one-eighth of the time. For precipitation, classes light, moderate, and heavy are defined so that each occurs one-third of the time on the average.

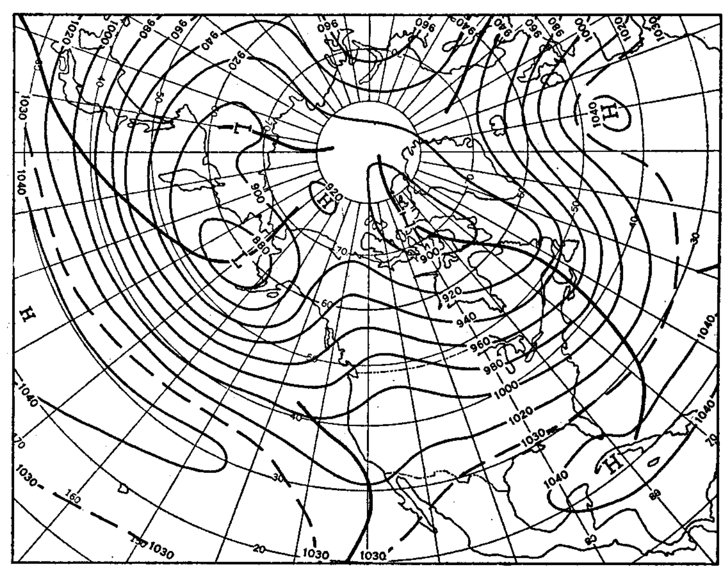


FIGURE 2.—Mean 700-mb. contours for November 1-15, 1952. Comparison with figure 1 shows significant phase changes in circulation pattern over much of the hemisphere at low and middle latitudes and over Eurasia at high latitudes.

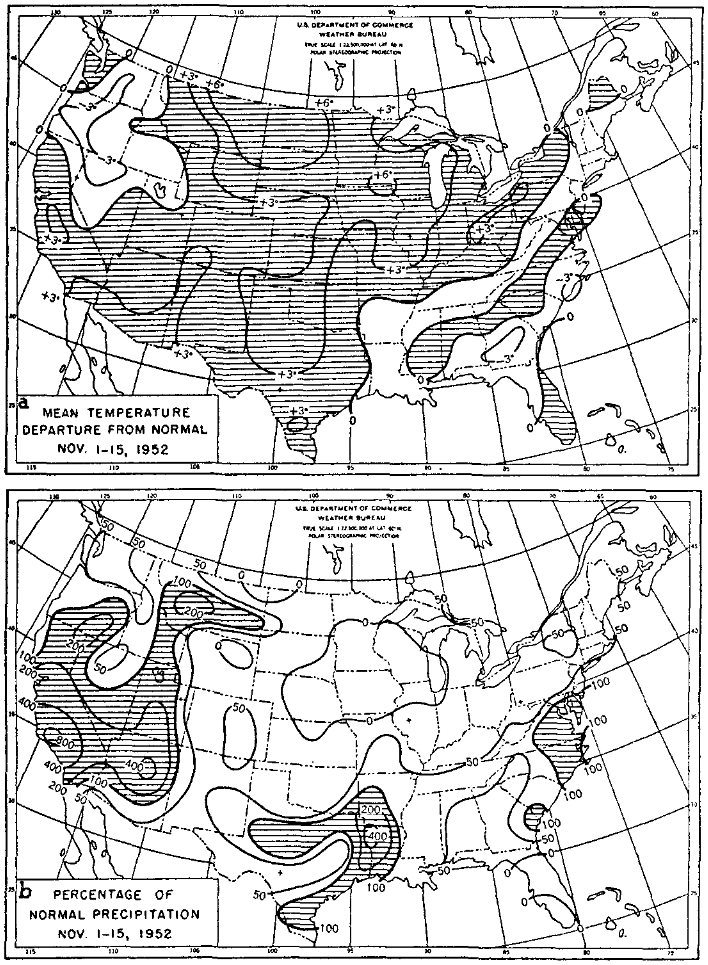



FIGURE 3.—Weather anomalies in the United States for the first half of November 1952. Comparison with figure 4 shows warming (a) in central United States and breaking of drought (b) over portions of United States.

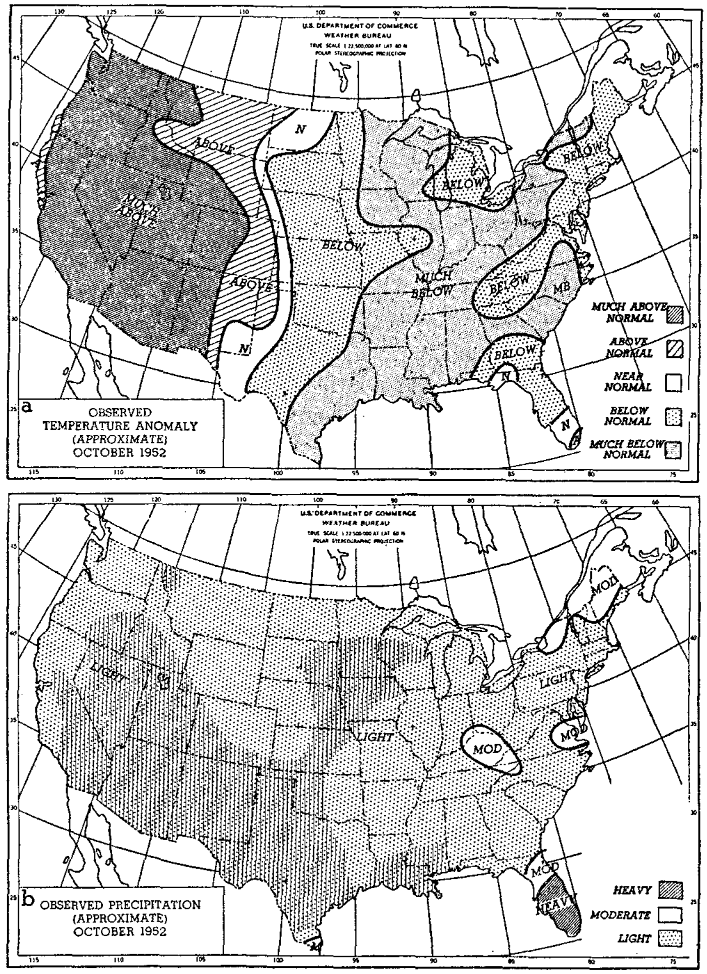



FIGURE 4.—Weather anomalies in the United States for October 1952. Definite warm-in-west, cold-in-east temperature pattern (a), and the driest month for the entire United States (b), which accompanied the October circulation pattern, figure 1. Overlaid hatching (b) indicates areas of no recorded precipitation.

turbations from the eastern Pacific, although only rarely did the sea level Lows show direct continuity from the Pacific. During this period the anticyclones (Chart IX) of the central and eastern United States remained south of 40°N. (in the area of anticyclonic shear at 700 mb.). Those in Canada were found either in the Hudson Bay area or the mountains of British Columbia. The latter occasionally advanced southeastward west of the Continental Divide and effected some of the cooling previously noted in the western United States.

Thus, during the first half of November about two-fifths of the country received precipitation in amounts sufficient to provide substantial drought relief. However, the Far Northwest and Northeast received insufficient moisture and the North Central portion none at all. The critical question at this point was whether the pattern "reversal" which had affected most of the systems of the hemisphere would now operate over North America where, during early November, its effects seemed limited almost exclusively to lower latitudes.

## THE SECOND HALF OF NOVEMBER

The features of figure 5 show that over North America the tendency for reversal did continue during the latter half of November. As trough conditions prevailed over the central Pacific, the eastern Pacific ridge continued to build, ultimately connecting with the western Canadian ridge which strengthened and retrograded. Associated with these developments was the apparent eastward motion of the California trough of early November. This strong low latitude trough came inland early in the latter half-month. As indicated by figure 5, it eventually tended to connect with the northern part of the old Atlantic coastal trough, which retrograded even more than did the Canadian ridge. Presumably the trough displacement was also influenced by retrogression of blocking action to the western Atlantic, although blocking continued to affect the eastern area as well. This tremendous blocking surge was unusually large and strong. The abnormal weakening of the Atlantic westerlies, at a time when they seasonally increase, can be seen by comparing figures 1 and 5.

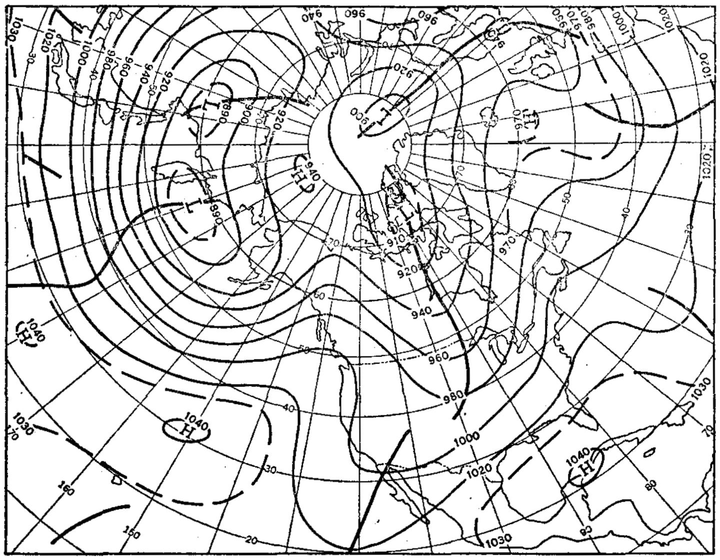


FIGURE 5.—Mean 700-mb. contours for November 16–30, 1952. Comparison with figure 1 shows changes in wave pattern at middle and low latitudes approximately 180 degrees in phase.

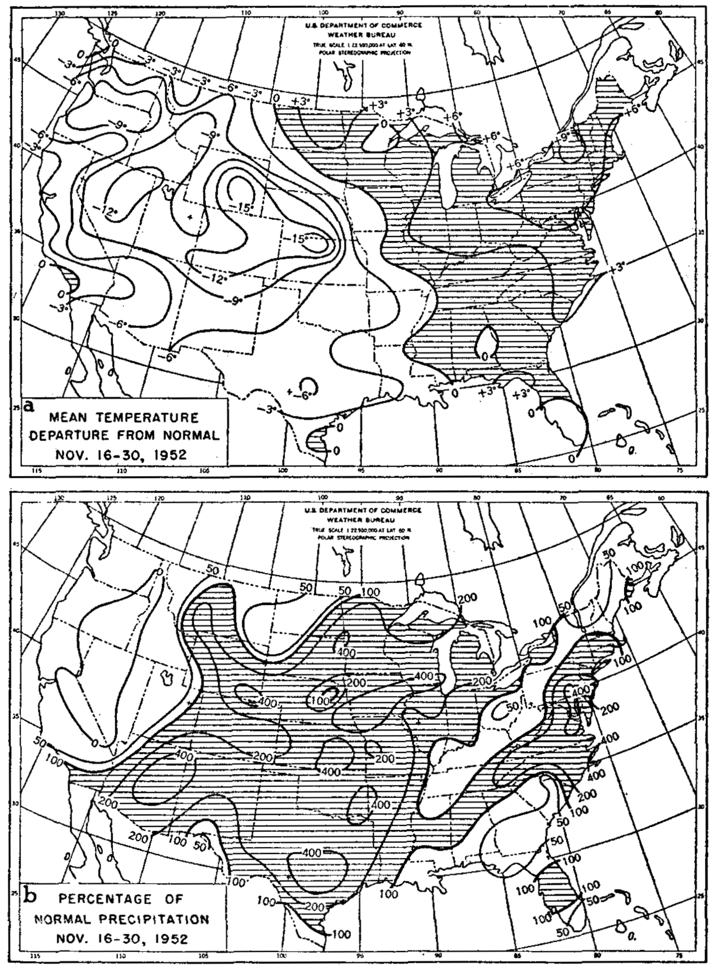



FIGURE 6.—Weather anomalies in the United States for the last half of November 1952. Decisive cooling in the west and warming in the east (a) completed the temperature reversal from October (see fig. 4a). Substantial precipitation amounts over large areas (b) accompanying the circulation pattern of figure 5 broke the drought over most remaining dry areas.

Comparison of these same figures over the area of the United States shows the complete reversal of low latitude features from October to the latter half of November. This "about face" at lower latitudes, combined with the retrogression and deepening of the upper latitued trough, resulted in further widespread drought relief over most of the remaining critical area. The anomaly for the latter half of November (fig. 6b) shows large precipitation amounts over a wide band from Arizona and Texas northeastward to the Great Lakes. A secondary above-normal precipitation area extended from Colorado north-northwestward along the Divide. This can be associated with over-running of the cold Highs (Chart IX) which moved southeastward from British Columbia and contributed to colder weather over the West. The narrow filament of above-normal precipitation from Mississippi to Virginia illustrates a feature frequently found in the fast flow downstream from areas of confluence (over Arkansas, fig. 5). However, the marked tendency for greater precipitation in the Middle Atlantic States, well removed from the confluence area, was probably related to the local maximum of cyclonic curvature.

Two fairly spectacular storms occurred among those which accompanied the circulation pattern of figure 5. The first of these was a cyclone [3] somewhat similar to the Thanksgiving Day storm of 1950. Chart X shows the deepening cyclone moving from northern Georgia on the 19th through the Carolinas on the 20th and 21st and then filling as it travelled northwestward around a blocking High over Labrador (Chart IX). The storm never equalled its famous predecessor but it did result in a record 18-in. snowfall at Knoxville, Tenn., with amounts ranging up to 22 in. over the mountainous area. Washington, D. C. had a three-day precipitation total of over 4½ in. with easterly winds of up to 60 m. p. h. causing abnormally high tides in the Potomac River and Chesapeake Bay. Equally important was the storm of the 25th–26th which moved north-northeastward over the Plains as it deepened. Blizzard conditions prevailed in areas of Kansas and Nebraska while a narrow snow blanket 6–9 in. deep covered a section from northern Texas to southeastern Minnesota. The winds, which reached 50 m. p. h. in gusts, swept many fields bare and drifted the snow. Small grains in the fields were exposed to the unseasonably low temperatures (below zero as far south as central Kansas) which followed in the wake of the storm.

[3] For further details see adjoining article by Smith and Roe.

## RÉSUMÉ FOR NOVEMBER

Monthly mean 700-mb. contours for November are presented in figure 7, the average of figures 2 and 5. If the chart described is made with references to figure 1, the October pattern, then the essential features and changes were: Trough instead of ridge conditions in southwestern United States, weakened Canadian ridge slightly farther west, deeper trough in central North America farther west than in October, elimination of the ridge in western Pacific, and strong blocking over the Atlantic with heights 420 ft. above normal over southern Greenland (fig. 7). At lower latitudes a phase shift of about 180 degrees can be noted from the Central Pacific through the Eastern Atlantic. At higher latitudes the phase shifts were much less prononuced in these longitudes, but were quite well marked in the Eastern Hemisphere.

The November temperature and precipitation anomalies for the United States are shown in figure 8 and Charts I, II, and III. The changes in anomaly patterns from October (fig. 4) to November are reflections of the lower latitude phase changes in the wave pattern. October was definitely warm in the West and cold in the East, while November was almost the opposite. October was the driest month on record and November saw the drought broken almost everywhere except the Far Northwest. It is significant that the heavy amounts of precipitation in November (fig. 8b) so nearly overlapped the no-precipitation areas of October (fig. 4b). The end of October's "fine" weather was welcomed everywhere.

## MONTH-TO-MONTH PERSISTENCE OF ANOMALIES

From the preceding discussion it is rather obvious that from October to November 1952 there occurred major changes in the circulation pattern with resultant changes in the mean weather anomalies. A similar reversal was noted last November [3]. The remainder of this article is a brief attempt to integrate these changes into the longer period pattern of persistence established by Namias [2].

The essential features of Namias' findings are shown in figure 9 where month-to-month persistence of tempera-

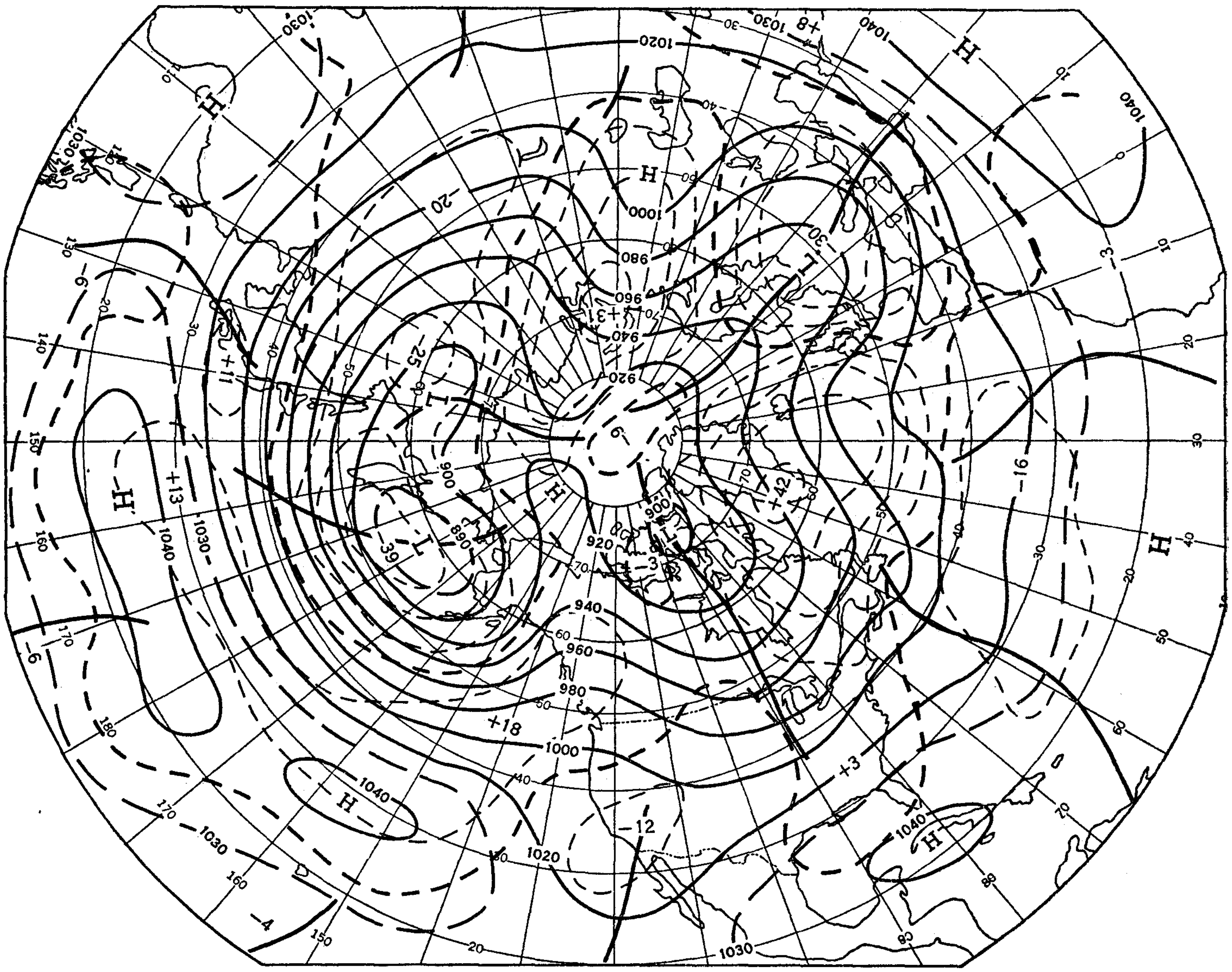



FIGURE 7.—Mean 700-mb. contours and departures from normal (labeled in tens of feet) for November 1–30, 1952. Note middle and lower latitude phase reversal from October (fig. 1). Unusually strong and widespread blocking spans the entire North Atlantic.

ture, precipitation, and 700-mb. mean height anomaly for the period of 1942–1950 are presented in order. The temperature persistence was defined as the percentage of area of the United States over which the temperature anomaly did not change by more than one class (for class definitions see footnote 2) from one month to the next. From the upper graph of figure 9 we see that the greatest temperature persistence occurred in mid-summer, namely, from July to August, with a secondary persistence maximum in the late winter. Periods of least persistence or greatest temperature reversal occurred about one month after the equinoxes, i. e. April to May and October to November. The average October to November persistence score for the period studied (1942–1950) was about 56 percent. In 1952, over only 29 percent of the country did the temperature persist from October to November.[4] This is far below the 56 percent average but it does not approach the 7 percent record (October to November 1947). If one considers the ultimate in reversal—a change from much above to much below or vice versa—24 percent of the country underwent such a change this fall.

[4] In 1951 the October to November persistence score was 45 percent.

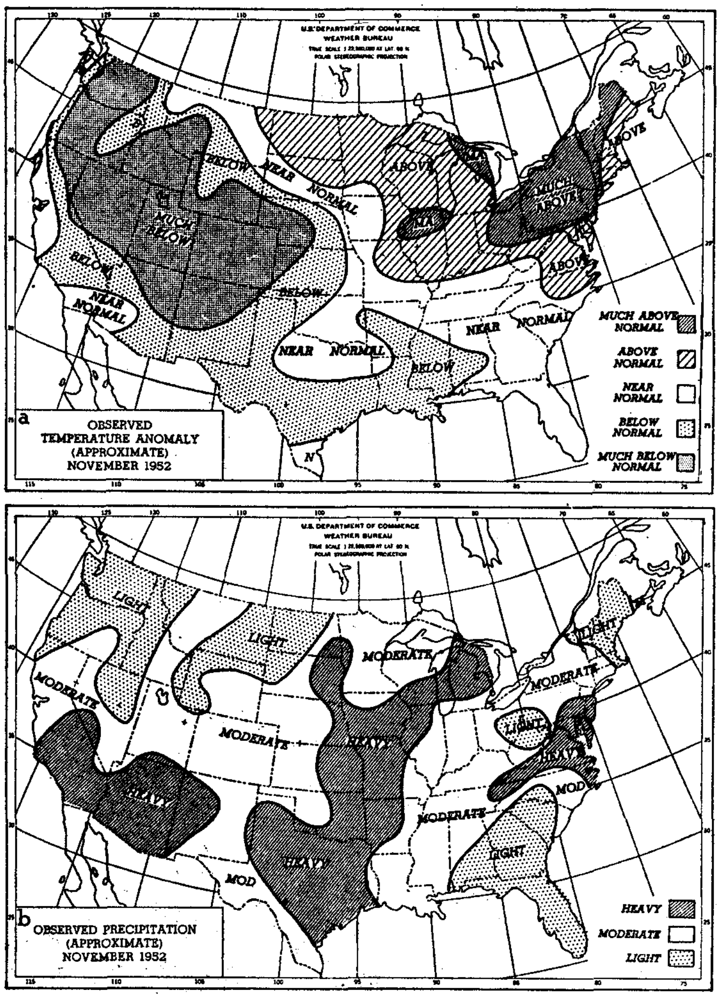



FIGURE 8.—Weather anomalies in the United States for November 1952. Comparison of these anomalies with those of October 1952 (figs. 4a and b) illustrates the striking reversal of monthly anomalies which frequently characterizes October–November weather regimes.

Precipitation persistence has been calculated similarly by determining the percentage of the country which does not change class at all. The middle graph, figure 9, presents the precipitation data for the same period (1942–1950). It indicates that the maximum of persistence in winter was greater than in summer, presumably due to the chaotic nature of summer precipitation patterns. More important, however, are indications that the April–May and October–November reversals were still conspicuous, with the October–November "break" being the better marked. The break in the precipitation regime this fall was statistically much less impressive than the temperature break, since persistence scored about 31 percent, a value quite close to the average October–November persistence. The lack of precipitation in sufficient quantities to raise classifications from the light category over all United States sections was not due to a failure of the reversal per se. The persistence score obtained was more a reflection of the unusually large dimensions of the circulation system of October compared to a system 180 degrees out of phase but of smaller dimensions in November. It is pertinent to point out that the heavy precipitation of November occurred in mid-United States which

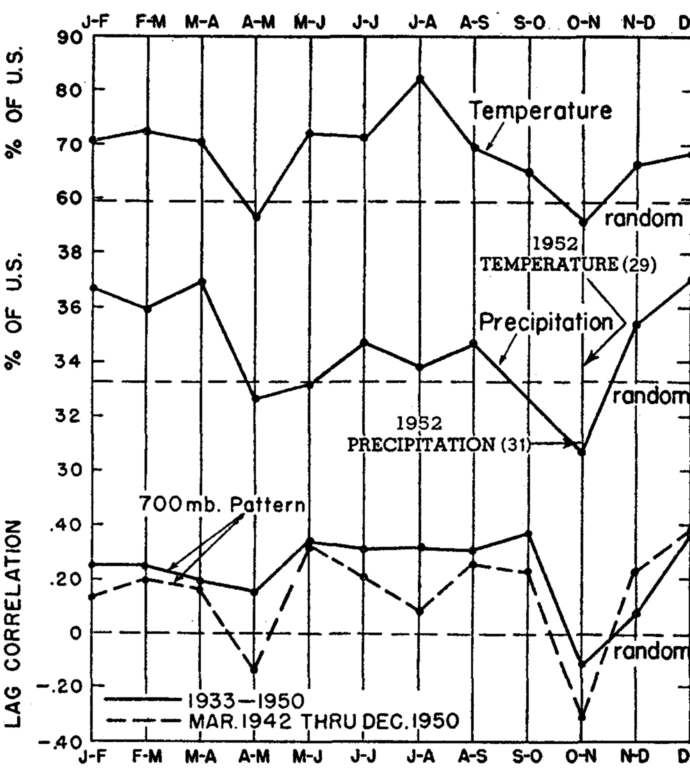



FIGURE 9.—Persistence of temperature anomaly (top) and precipitation anomaly (middle) over the United States for period March 1942–December 1950. Values of temperature and precipitation persistence for October–November 1952 are indicated by arrows. Bottom: Correlations between patterns of 700-mb. height anomaly for successive months (broken line, 1942–50; solid line, 1933–50). Note that all graphs show minima of persistence about one month after the equinoxes and that the longer period of record indicates the spring and fall reversals have been most marked in recent years. (After Namias [2].)

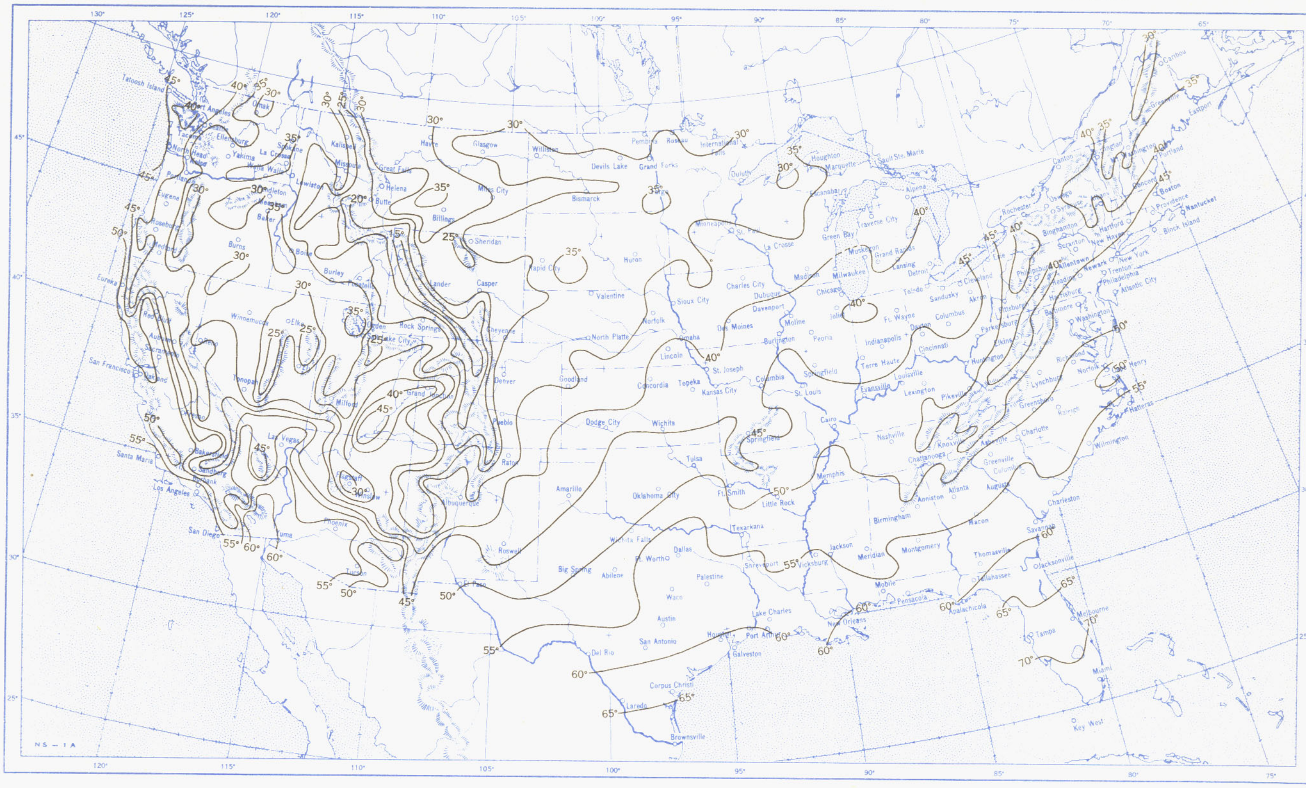
was presumably the center of the "light" October anomaly.

The lower graphs, figure 9, show the month-to-month persistence of 700-mb. mean height anomalies. That this circulation parameter shows similar characteristics to the preceding elements is apparent by inspection of the lower broken-line graph which encompasses the same period as the upper graphs. Characteristics such as these cannot be reliably established upon only 9 years of data. The lower solid-line graph more than doubles the period surveyed and indicates that the 1942–50 period showed more reversal than was experienced over the longer period from 1933–50. The occurrences of strong October–November reversals in 1951 and 1952 indicate that the tendency for a minimum of persistence in the fall is a continuing characteristic of the current decade.

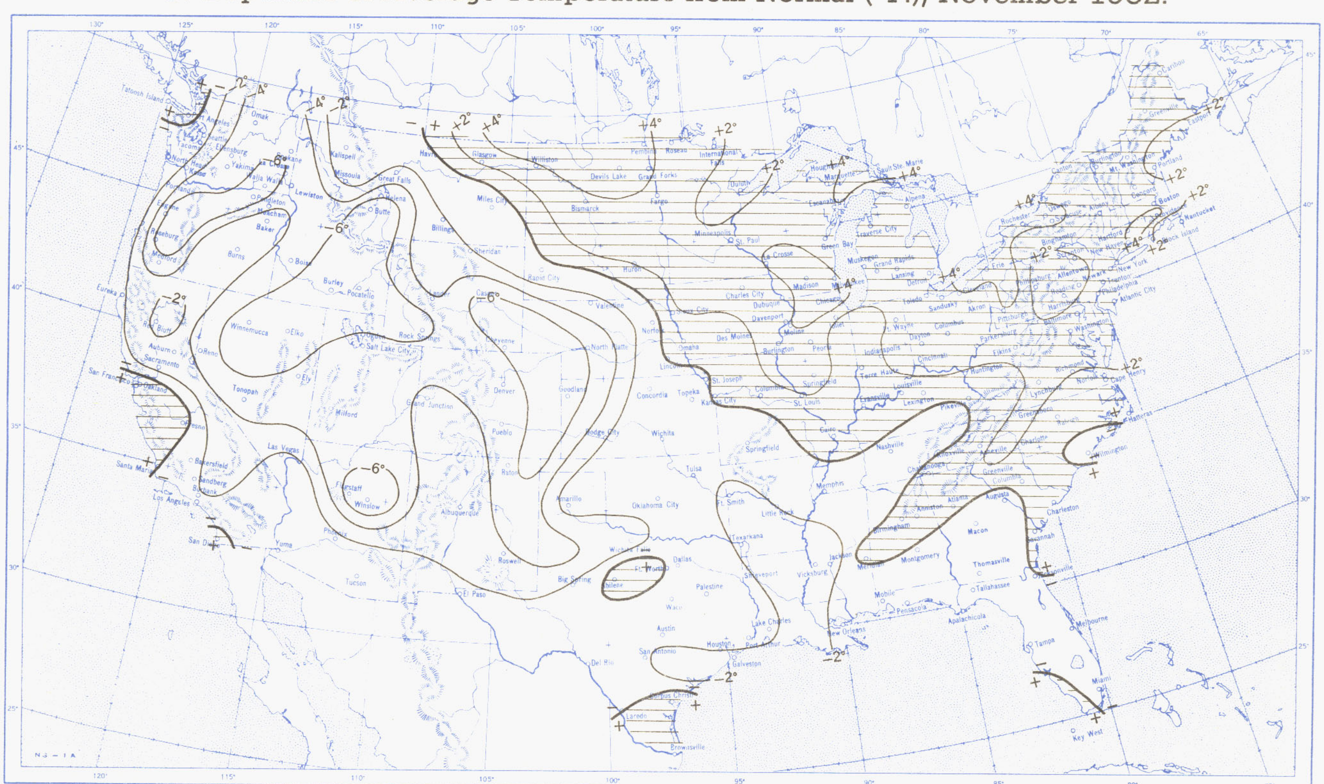
## REFERENCES

1. J. S. Winston, "The Weather and Circulation of October 1952, The Driest Month on Record in the United States", *Monthly Weather Review*, vol. 80, No. 10, October 1952, pp. 190–194.
2. J. Namias, "The Annual Course of Month-to-Month Persistence in Climatic Anomalies", *Bulletin of American Meteorological Society*, vol. 33, No. 7, September 1952, pp. 279–285.
3. W. H. Klein, "The Weather and Circulation of November 1951," *Monthly Weather Review*, vol. 79, No. 11, November 1951, pp. 208–211.

## Chart I. A. Average Temperature (°F.) at Surface, November 1952.



## B. Departure of Average Temperature from Normal (°F.), November 1952.

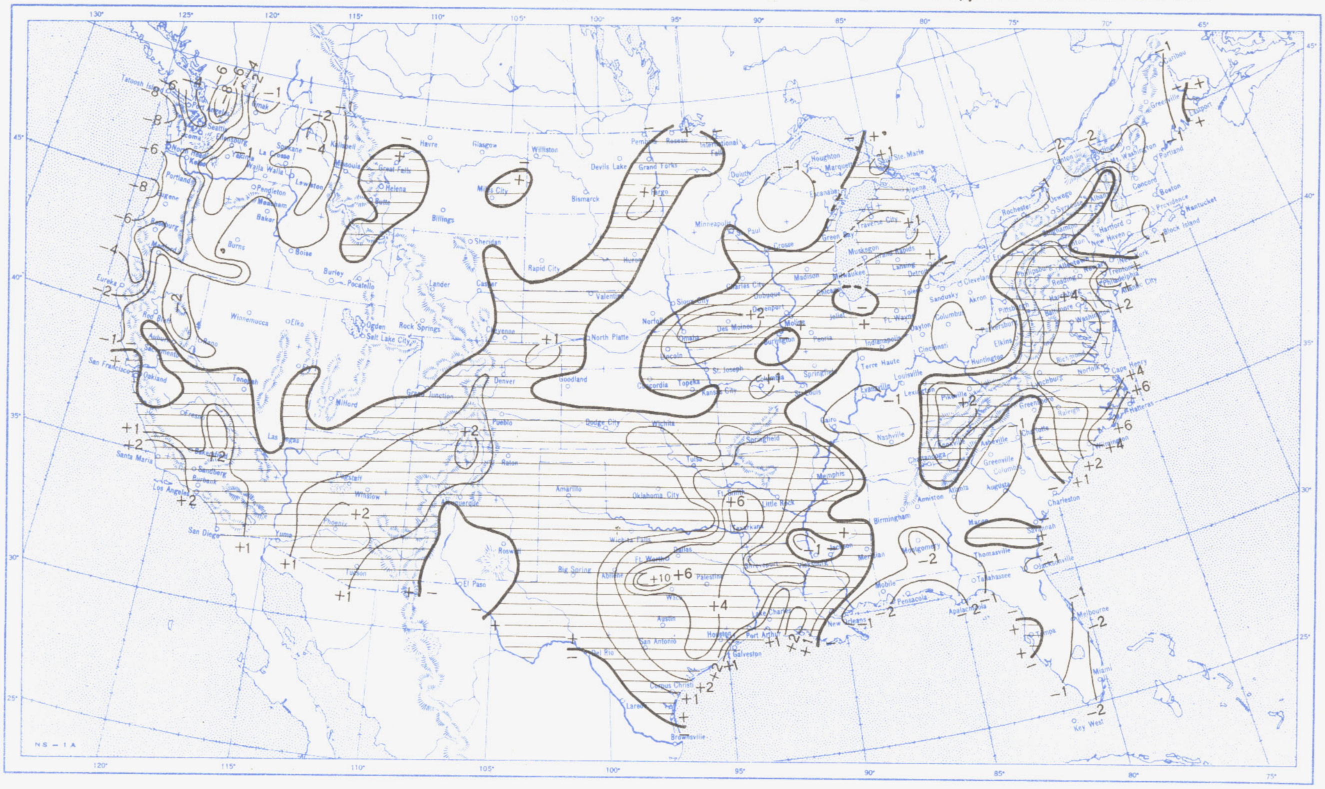


A. Based on reports from 800 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively.
B. Normal average monthly temperatures are computed for Weather Bureau stations having at least 10 years of record.

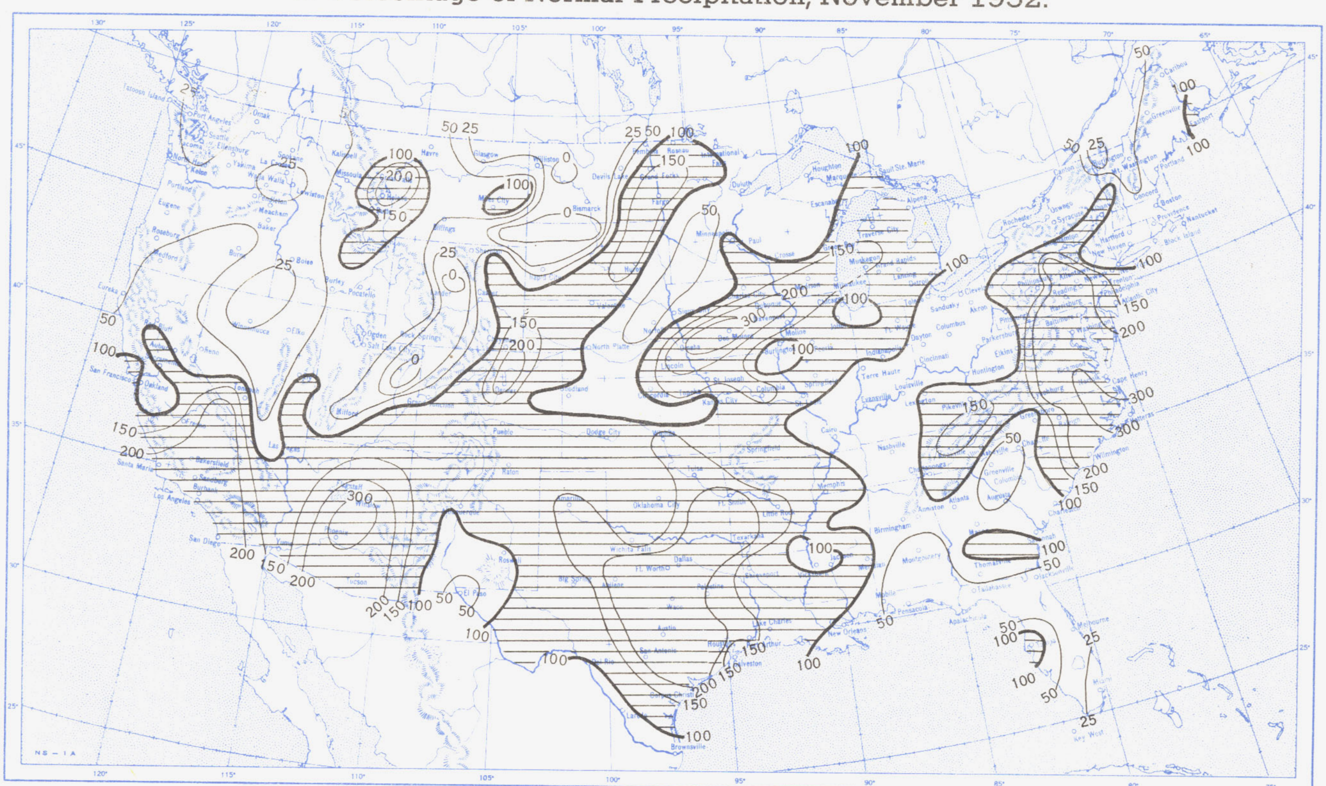
Chart II. Total Precipitation (Inches), November 1952.


Based on daily precipitation records at 800 Weather Bureau and cooperative stations.

## Chart III. A. Departure of Precipitation from Normal (Inches), November 1952.

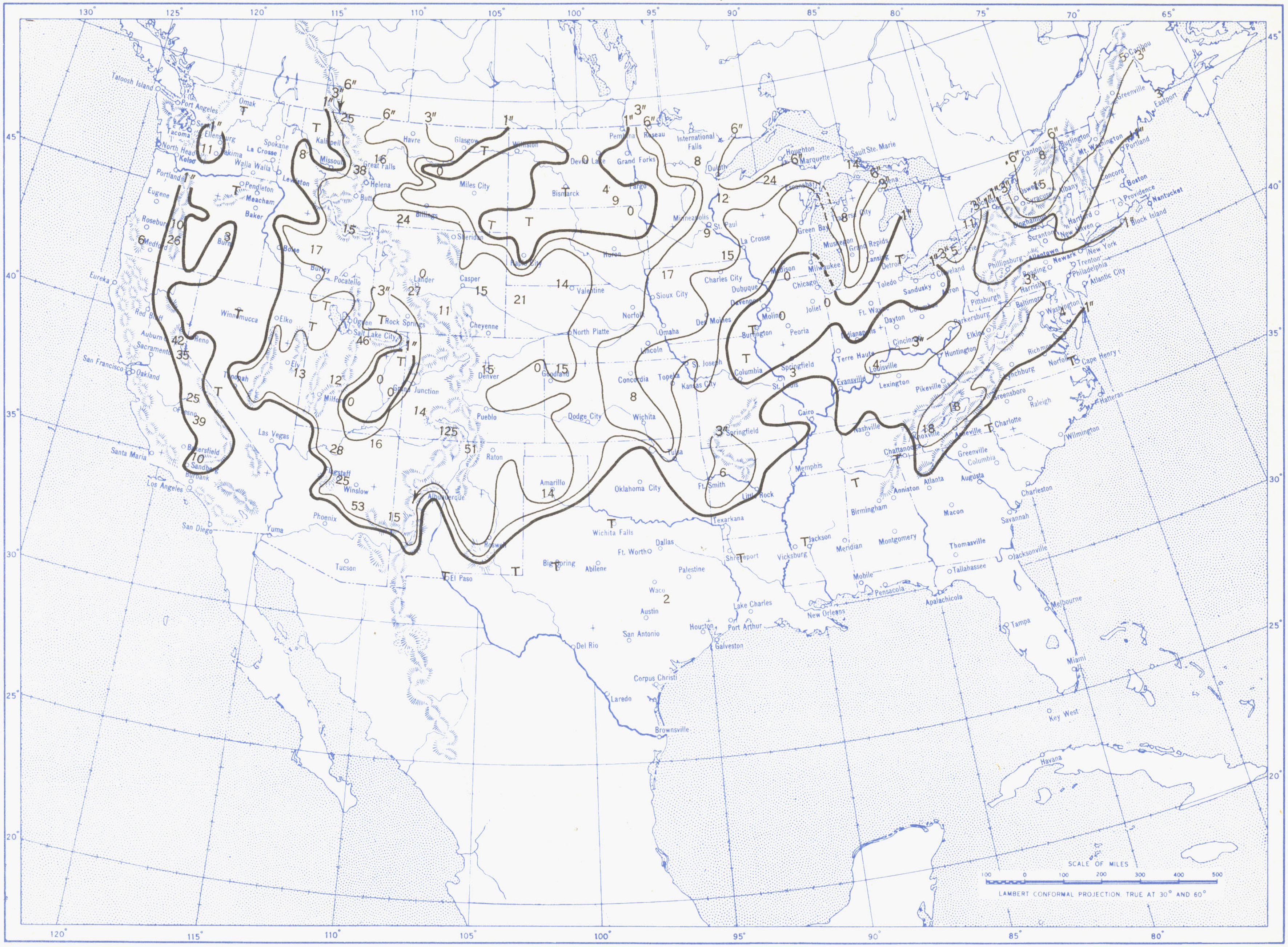


## B. Percentage of Normal Precipitation, November 1952.



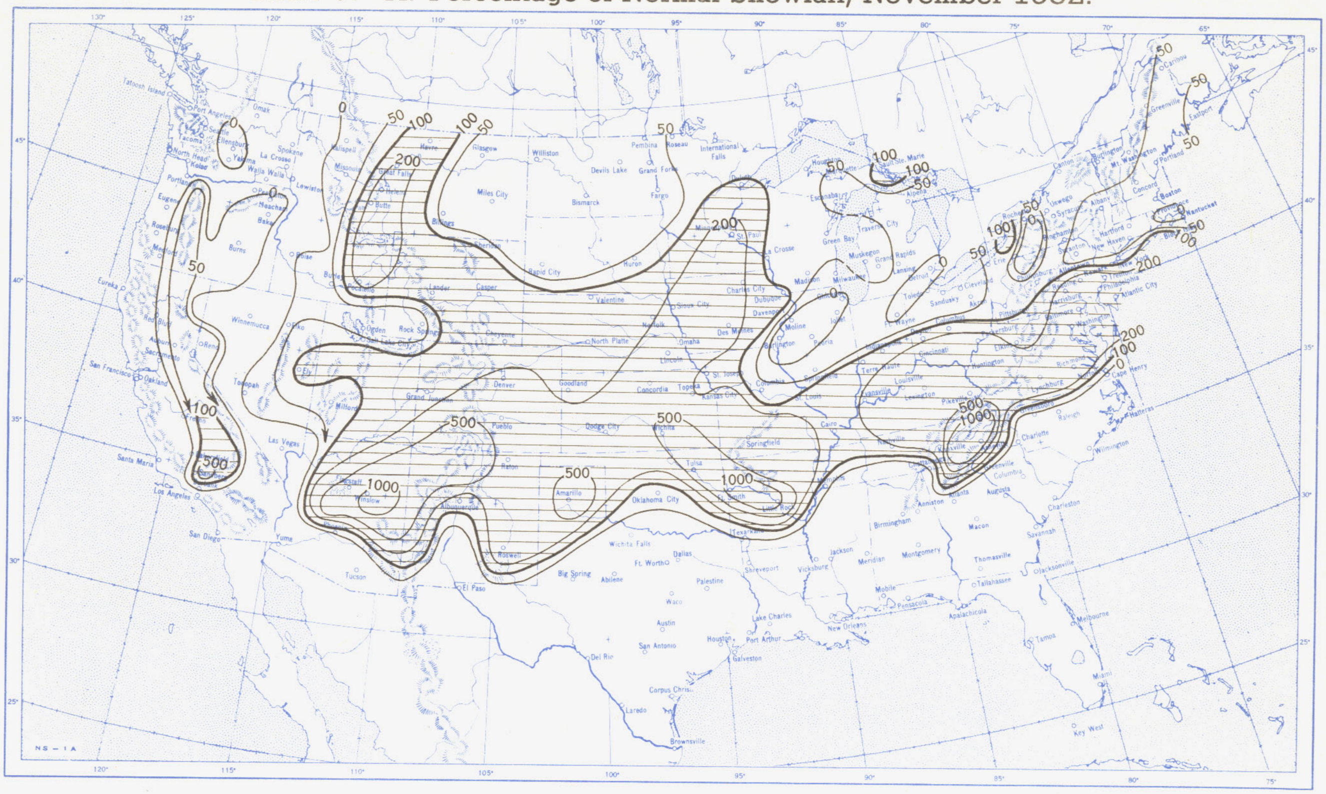
Normal monthly precipitation amounts are computed for stations having at least 10 years of record.

# Chart IV. Total Snowfall (Inches), November 1952.

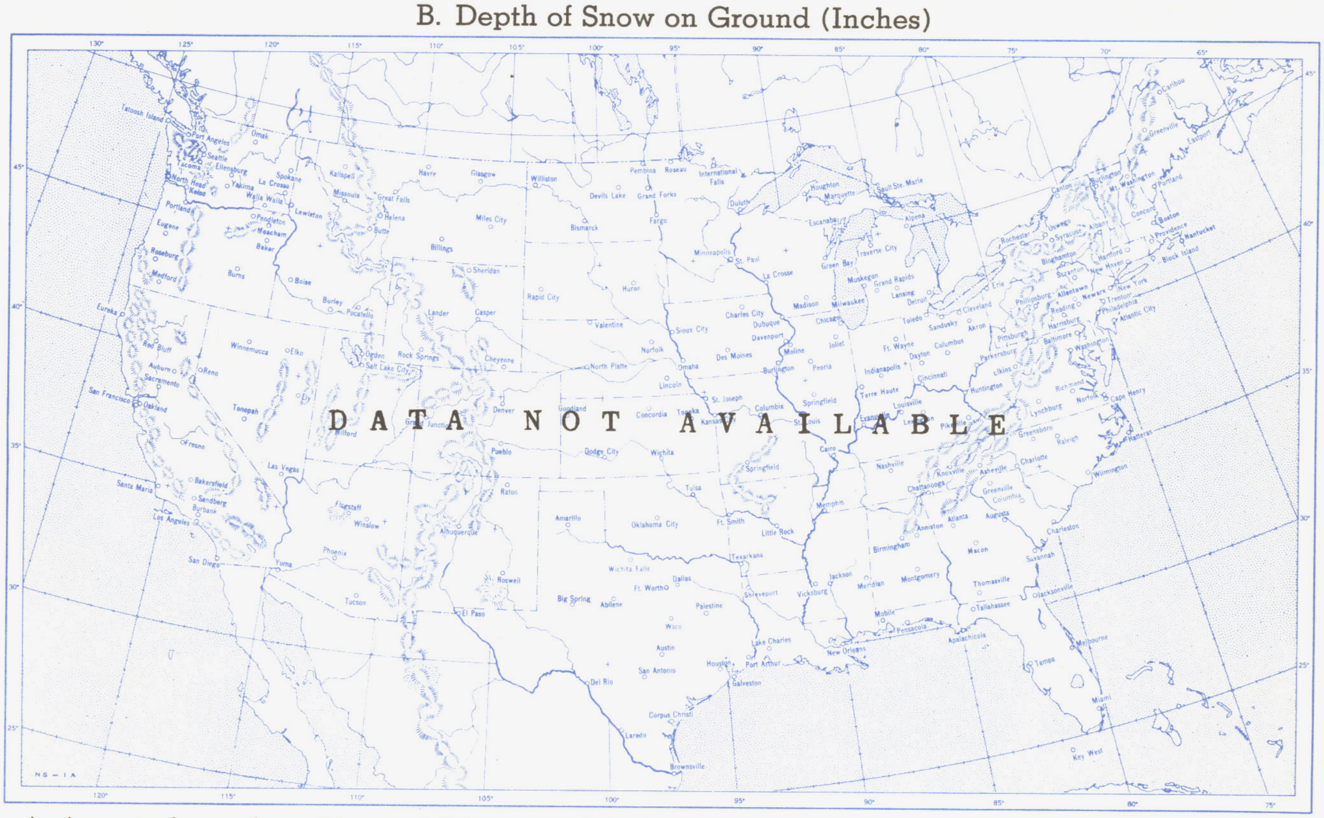



This is the total of unmelted snowfall recorded during the month at Weather Bureau and cooperative stations. This chart and Chart V are published only for the months of November through April although of course there is some snow at higher elevations, particularly in the far West, earlier and later in the year.

## Chart V. A. Percentage of Normal Snowfall, November 1952.

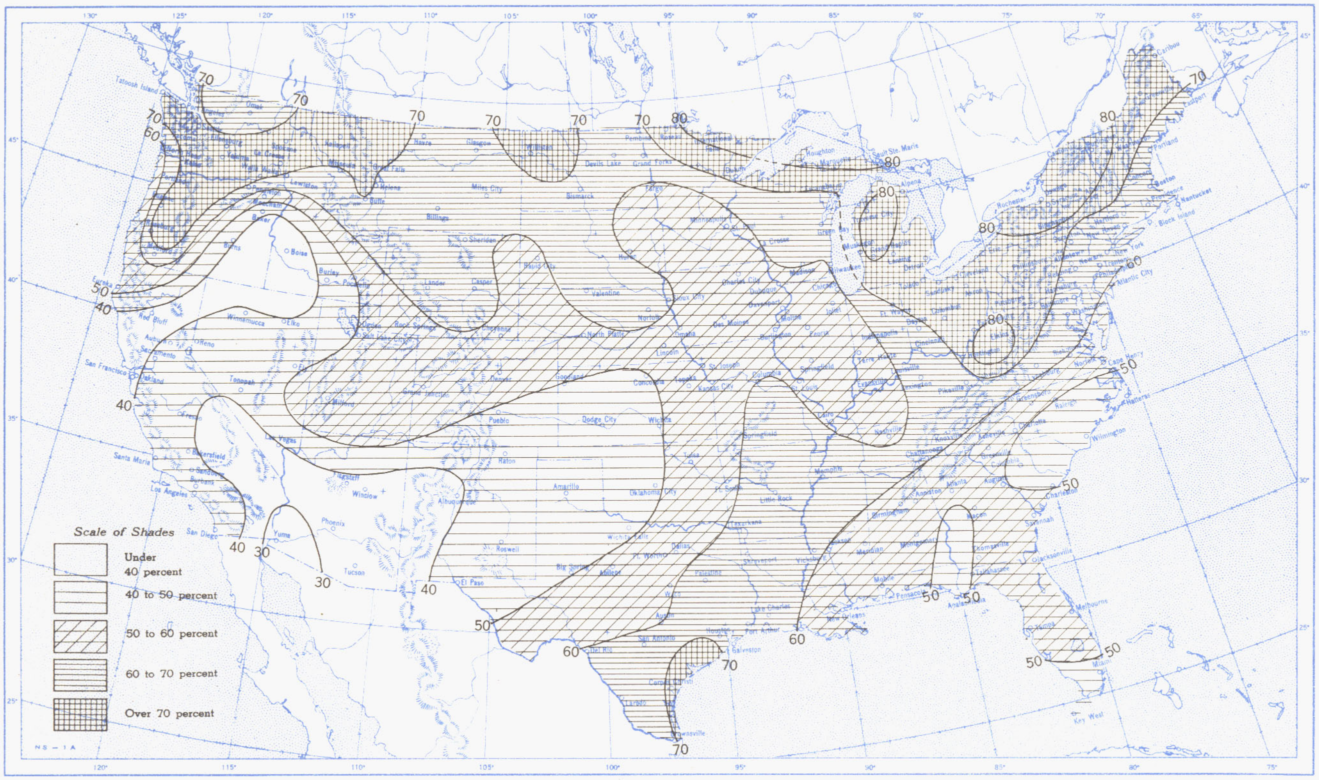


## B. Depth of Snow on Ground (Inches)

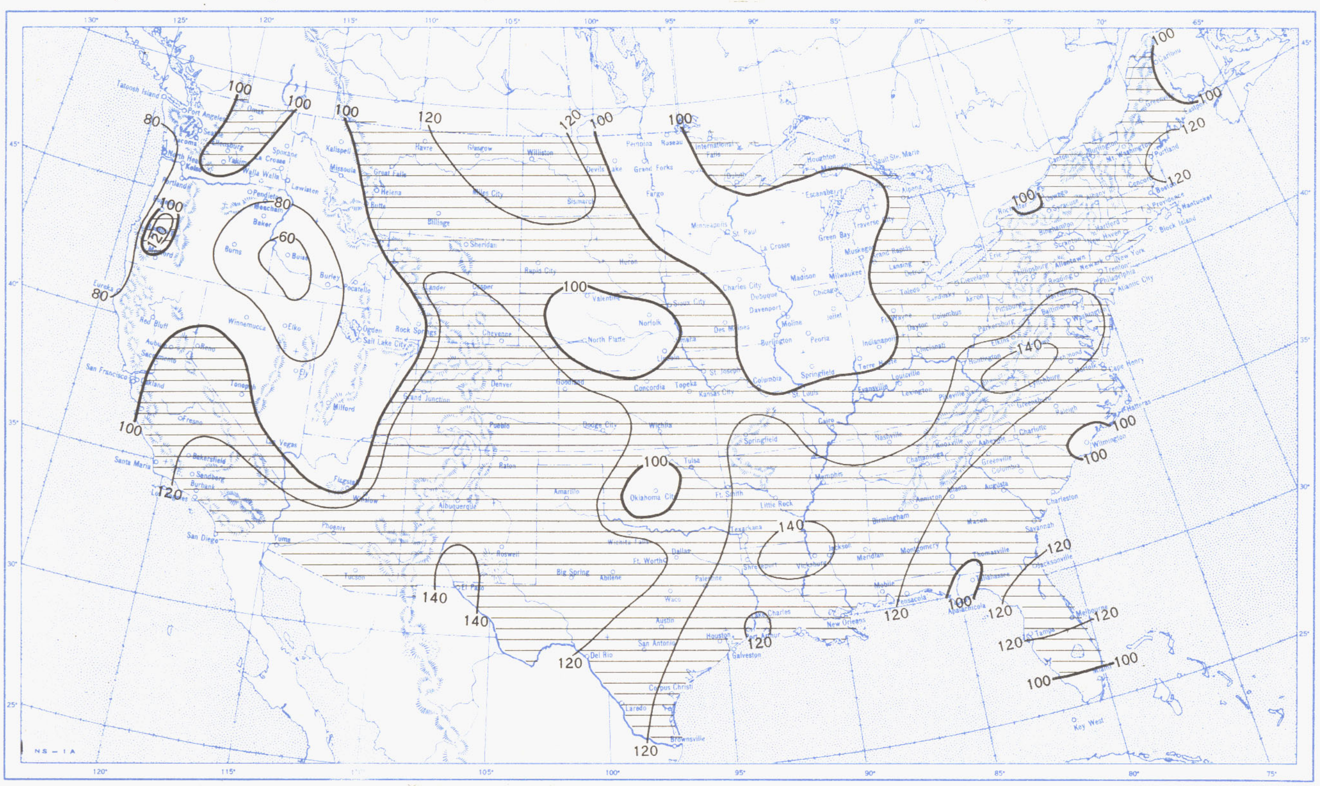



A. Amount of normal monthly snowfall is computed for Weather Bureau stations having at least 10 years of record.
B. Shows depth currently on ground at 7:30 a. m. E. S. T., of the Tuesday nearest the end of the month. It is based on reports from Weather Bureau and cooperative stations. Dashed line shows greatest southern extent of snowcover during month.

## Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, November 1952.

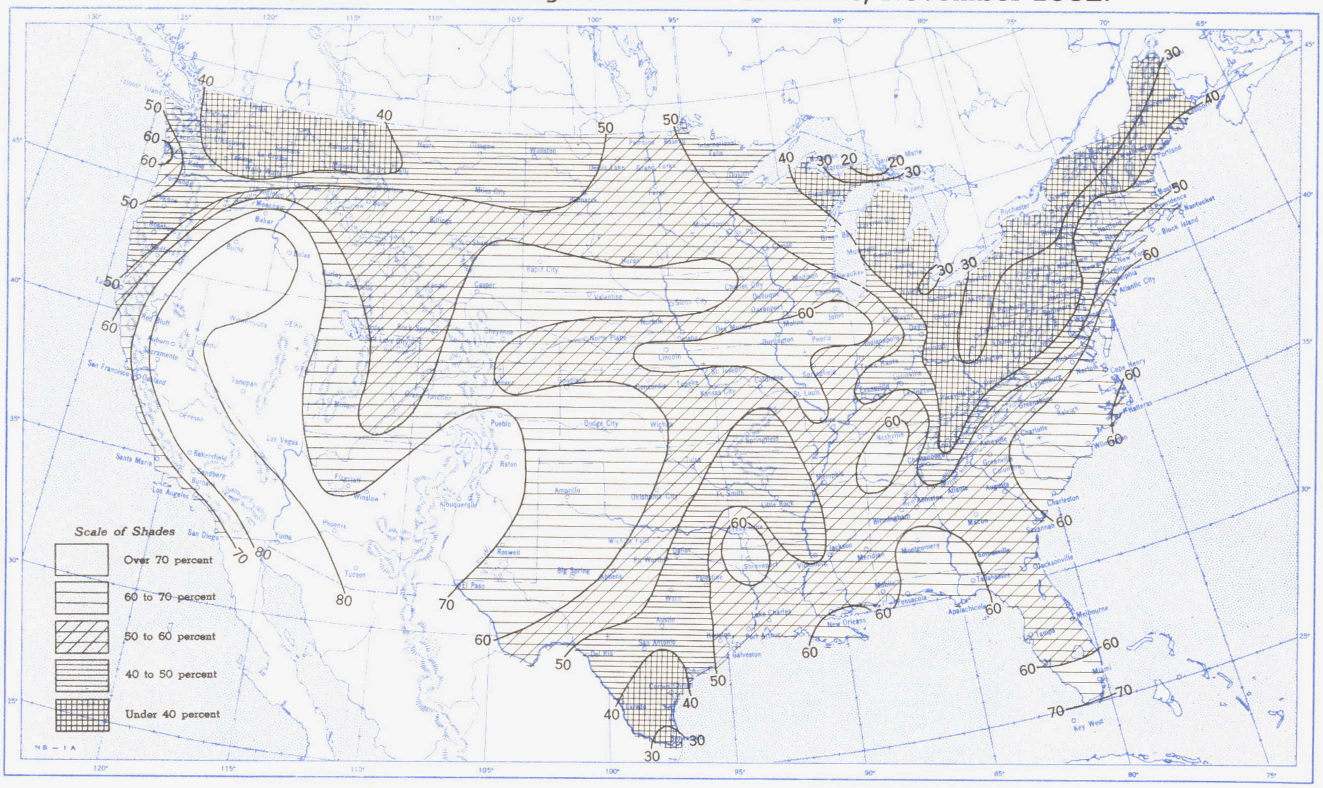



## B. Percentage of Normal Sky Cover Between Sunrise and Sunset, November 1952.

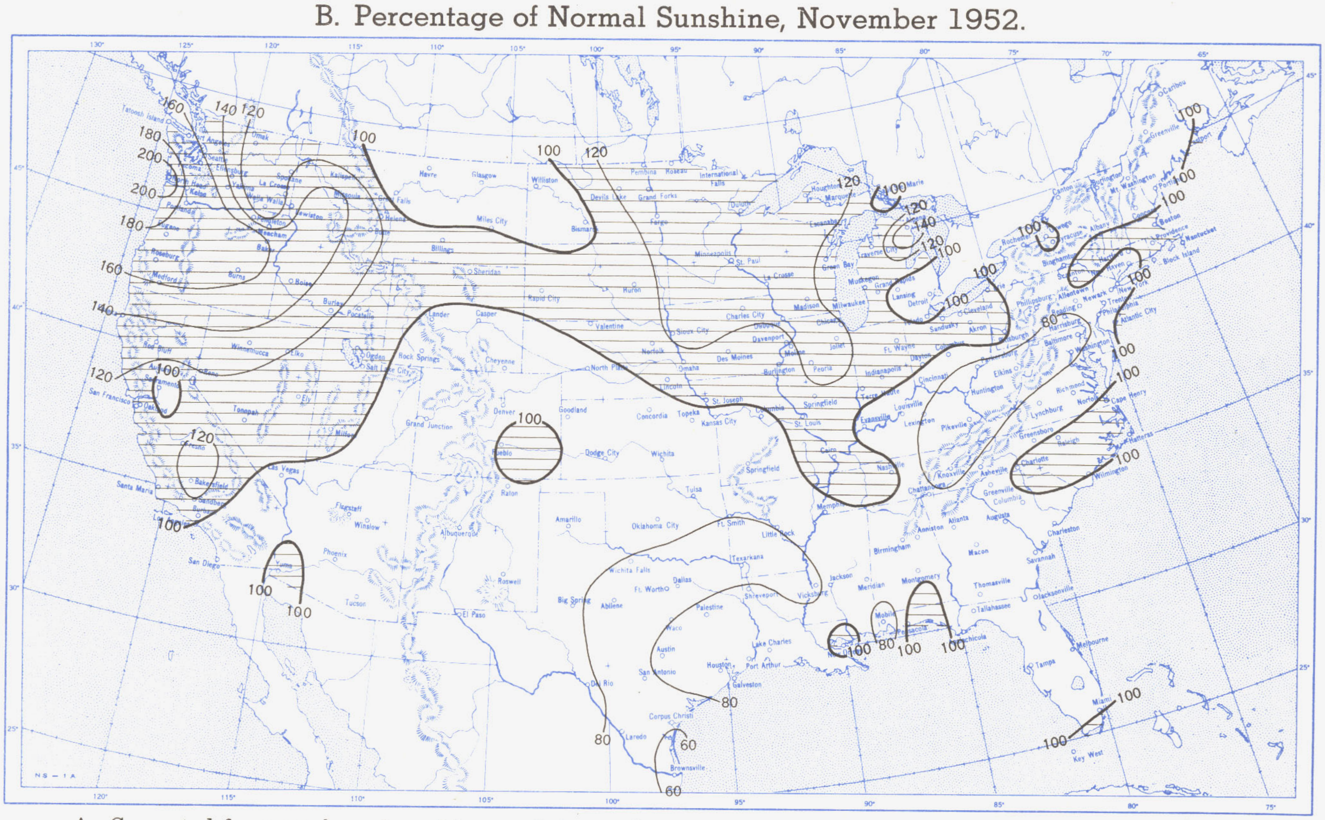


A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.

## Chart VII. A. Percentage of Possible Sunshine, November 1952.




## B. Percentage of Normal Sunshine, November 1952.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.

Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, November 1952. Inset: Percentage of Normal Average Daily Solar Radiation, November 1952.

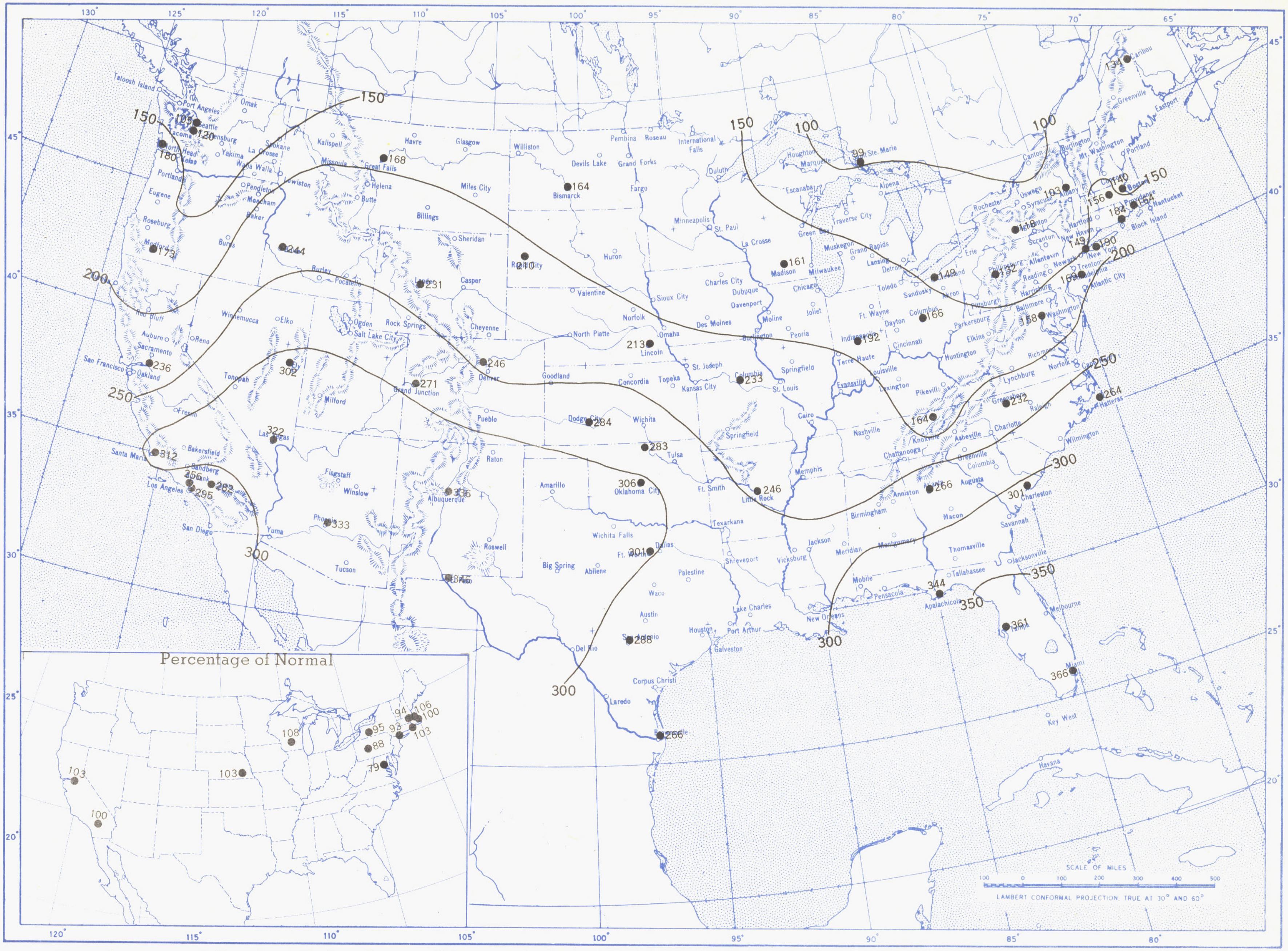
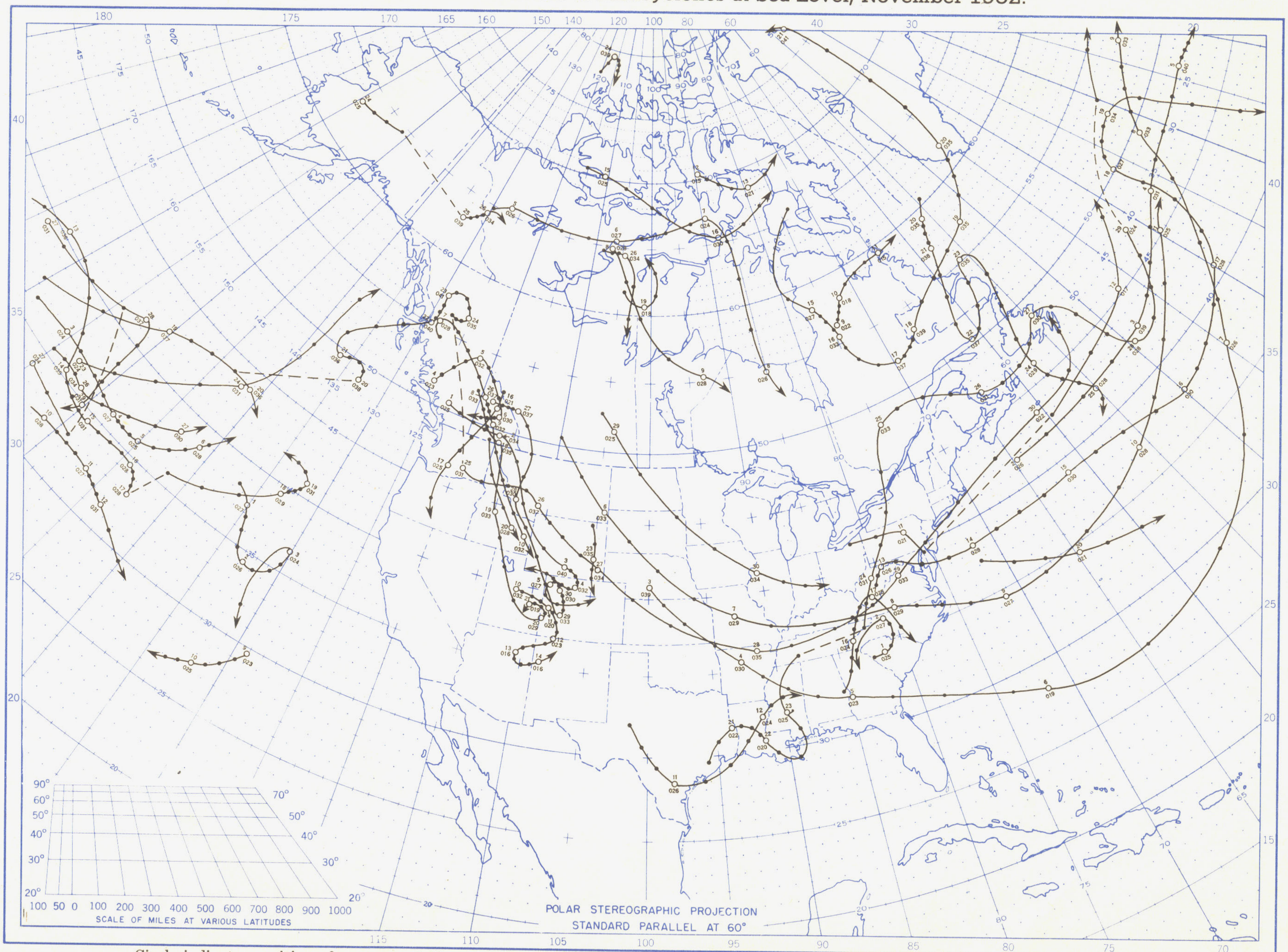




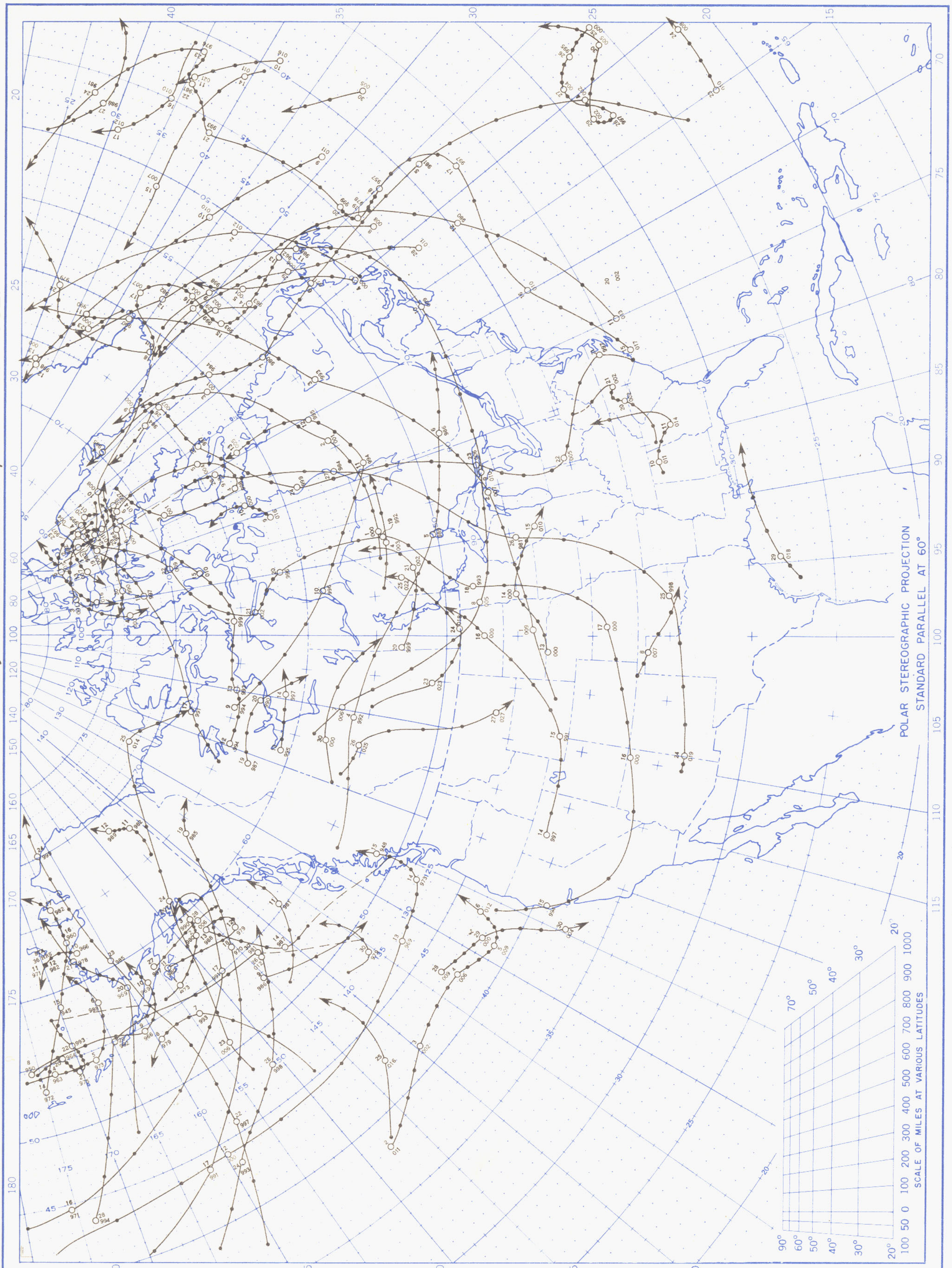

Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langleys (1 langley = 1 gm. cal. cm. $^{-2}$). Basic data for isolines are shown on chart. Further estimates are obtained from supplementary data for which limits of accuracy are wider than for those data shown. Normals are computed for stations having at least 9 years of record.

# Chart IX. Tracks of Centers of Anticyclones at Sea Level, November 1952.



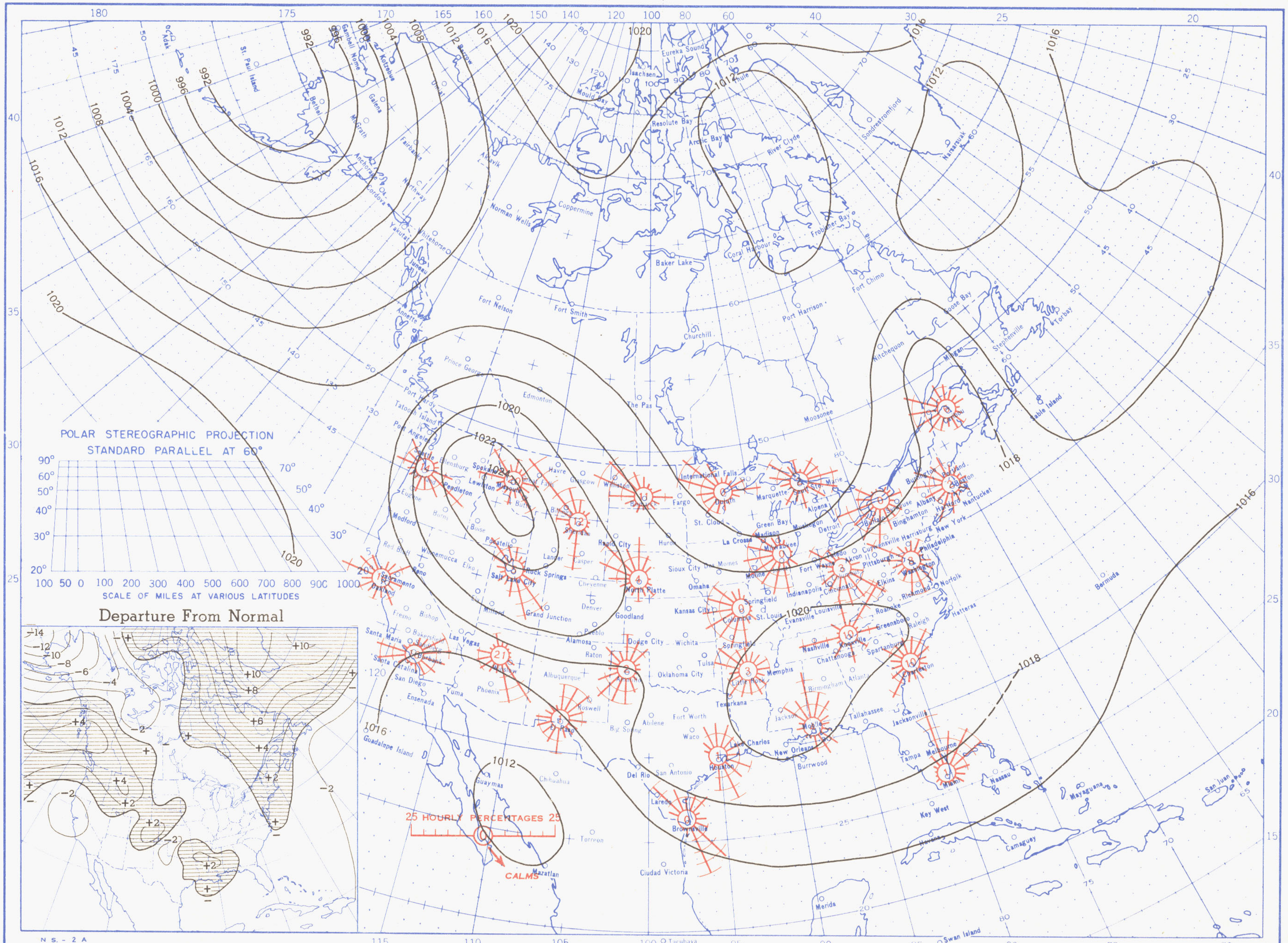

Circle indicates position of center at 7:30 a. m. E. S. T. Figure above circle indicates date, figure below, pressure to nearest millibar. Dots indicate intervening 6-hourly positions. Squares indicate position of stationary center for period shown. Dashed line in track indicates reformation at new position. Only those centers which could be identified for 24 hours or more are included.

## Chart X. Tracks of Centers of Cyclones at Sea Level, November 1952.



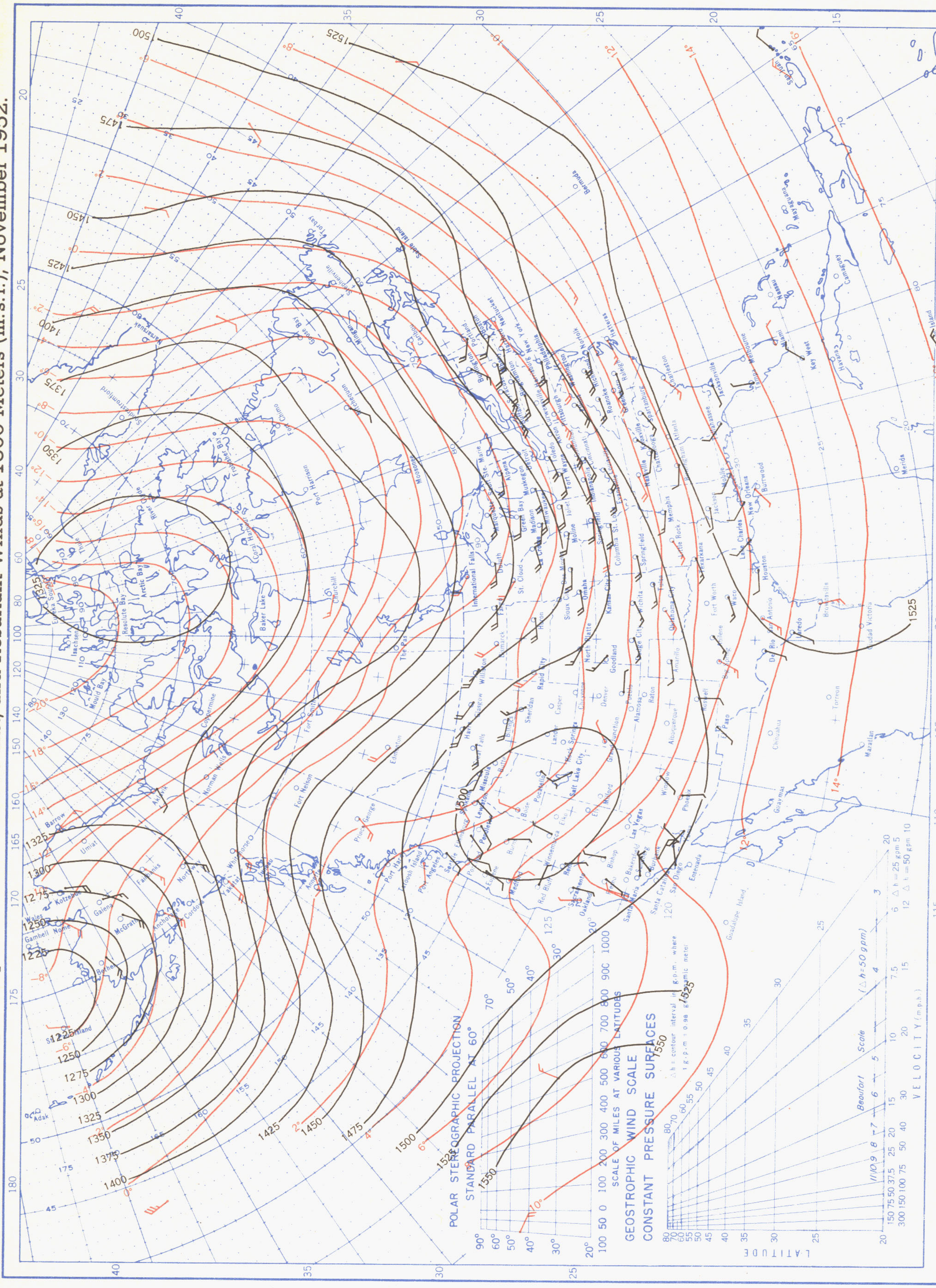

Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.

Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, November 1952. Inset: Departure of Average Pressure (mb.) from Normal, November 1952.



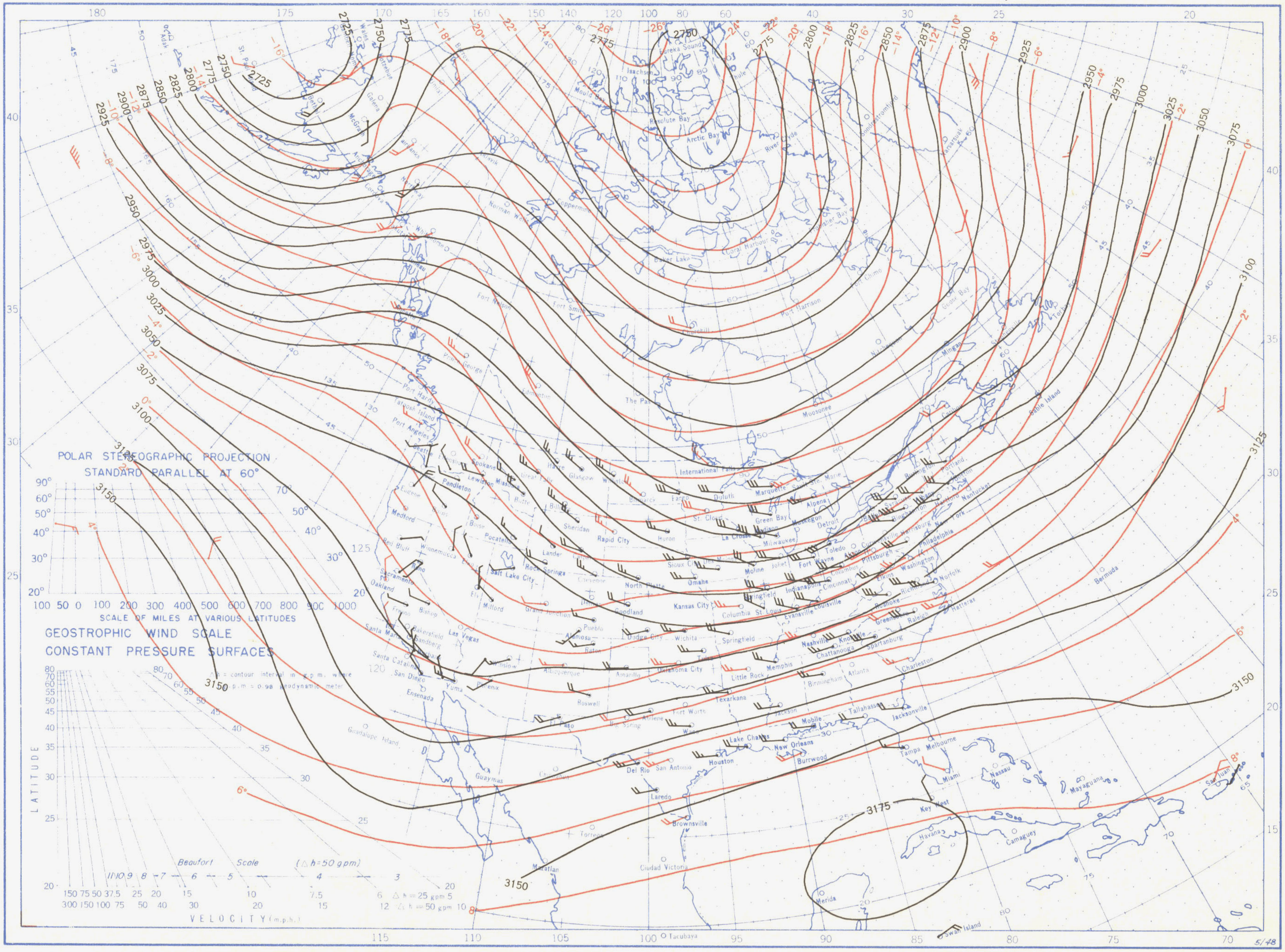

Average sea level pressures are obtained from the averages of the 7:30 a. m. and 7:30 p. m. E. S. T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° intersections in a diamond grid based on readings from the Historical Weather Maps (1899-1939) for the 20 years of most complete data coverage prior to 1940.

Chart XII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 850-mb. Pressure Surface, Average Temperature in °C. at 850 mb., and Resultant Winds at 1500 Meters (m.s.l.), November 1952.




Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T.

Chart XIII. Average Dynamic Height in Geopotential Meters (1 g.p.m.. = 0.98 dynamic meters) of the 700-mb. Pressure Surface, Average Temperature in °C. at 700 mb., and Resultant Winds at 3000 Meters (m.s.l.), November 1952.




Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T.

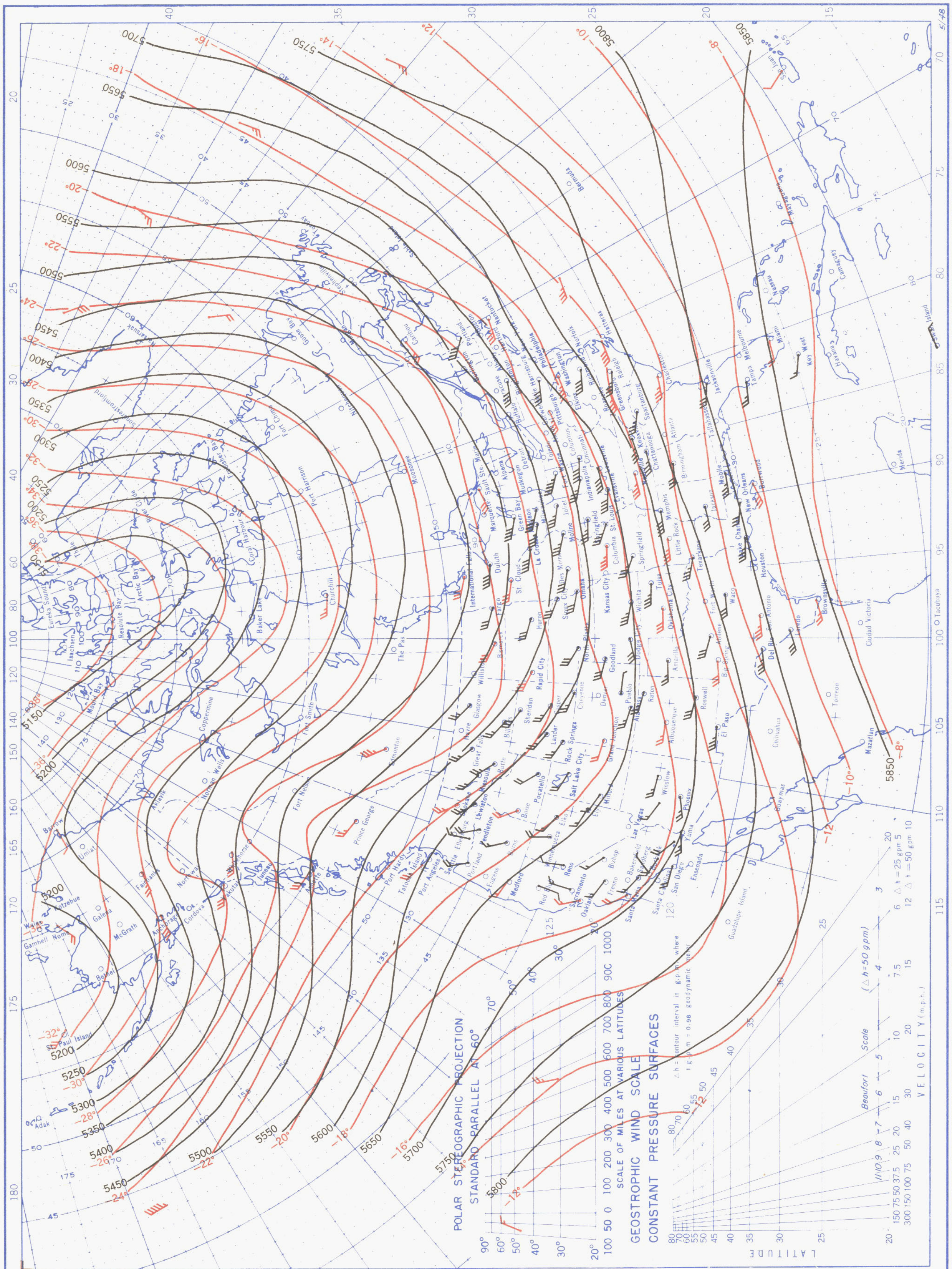
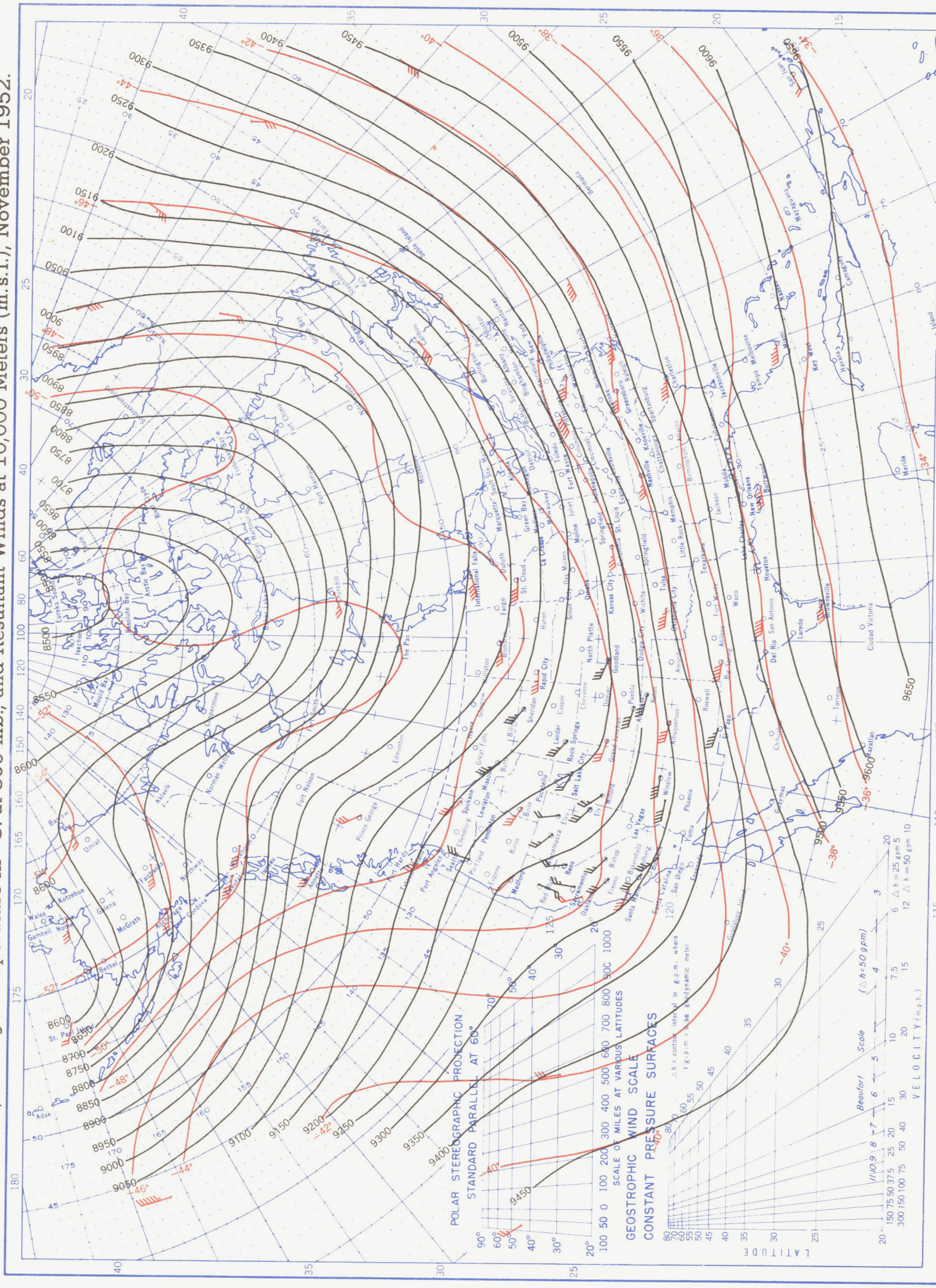



Chart XIV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 500-mb. Pressure Surface, Average Temperature in °C. at 500 mb., and Resultant Winds at 5000 Meters (m.s.l.), November 1952.

Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T.

Chart XV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 300-mb. Pressure Surface, Average Temperature in °C. at 300 mb., and Resultant Winds at 10,000 Meters (m.s.l.), November 1952.




Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T.